REMARKS

The applicant respectfully requests reconsideration of the rejections set forth in the official action in view of the foregoing amendments and the following remarks.

The Amendments

Claims 1 and 8 have been amended. Written support for the terms added by the amendments can be found as follows.

"Multiple inputs . . .": Figure 1 and in the text at page 7, lines 28-33.

Use of orthonormal cross-coupling matrix/matrices: Figure 3; text at page 8, line 19, to page 9, line 24; and Claims 4 and 11 as originally filed.

35 USC 112, First Paragraph: Claims 2, 3, 4, 9, 10, and 11

The Examiner rejected Claims 2, 3, 4, 9, 10, and 11 under 35 USC 112, first paragraph, because the Examiner concluded that those claims do not meet the enablement requirement set forth in the statute. Specifically the Examiner stated:

> Claims 2, 3, 4, 9, 10 and 11 is [*sic*] nonenabling because claim 1 recites "one or more microphones", wherein the case where one microphone is used, only one input is inputted to a matrix or matrices, therefore not able to cross couple the input signal to any other signals.

The amendments to Claims 1 and 8 are made in response to the 35 USC 112 rejection. More specifically, Claim 1 has been amended to recite:

> An in-line early reflection enhancement system comprising:
>
> multiple inputs for receiving multiple input signals from one or more microphones positioned close to one or more sound sources within a room or other space so as to detect predominantly direct sound.....

Claim 8 has been amended to recite:

A method for enhancing the acoustics of a room or auditorium comprising detecting predominantly direct sound with one or more microphones positioned close to one or more sound sources and providing multiple input signals,....

Claims 2 and 9 have been cancelled. Claim 4 is now dependent only from Claim 3 and Claim 10 is dependent only from Claim 8.

The pending claims as amended require multiple inputs, from one or more microphones. Accordingly, the claims as now presented are believed to be enabling and in conformance with the first paragraph of Section 112 of the statute.

It is noted that it is possible that multiple inputs or output signals could be provided by replicating the output signal from a single microphone. That is, a single microphone could provide multiple inputs to an n-channel unitary system to provide multiple outputs. Therefore, the Applicant does not wish to amend claims 1 and 8 to recite multiple microphones.

35 USC 103(a): Claims 1-5 and 8-12

The Examiner rejected claims 1 to 5 and 8 to 12 under 35 USC 103 (a) as unpatentable over US Patent No. 5,440,639 (Suzuki), and separately over US Patent No. 5,555,306 (Gerzon).

Claims 1 and 8 are the only independent claims pending in this application. Claim 1 is now amended to require that the early reflection generation stage comprises "at least one cross-coupling matrix which is an orthonormal cross-coupling matrix". Claim 8 has been amended to require that the early reflection generation stage used for "generating a number of delayed discrete reproductions of the input signals" comprises "at least one cross-coupling matrix which is an orthonormal cross-coupling matrix". Claims 1 and 8 also require that the early reflection generation stage has a finite impulse response and, without internal feedback, generates a number of delayed

discrete reproductions of the input signals, which have unitary power gain, whereby the stability of the system is independent of delay times and amplitudes.

The Applicant's claimed system and method as defined in the amended claims employ a specific subset of cross-coupling matrices, namely at least one orthonormal matrix with unitary delays, to produce a multichannel unitary response. The use of an orthonormal matrix is not obvious from either Suzuki or Gerzon.

In order to be unitary, a multiple input, multiple output audio processor must use unitary sub-units. Applicant's invention comprises an early reflection enhancement system which consists of unitary sub-blocks connected in series. These sub-blocks are either orthonormal matrices (which are unitary) or delays without cross-coupling, which are also unitary (the cross-coupling of delays destroys the unitary property). The overall system transfer function matrix is the product of the sub-block matrices, and the system remains unitary because the product of unitary matrices is itself unitary. The systems described in Suzuki and Gerzon do not contain unitary sub-blocks, and therefore, the overall system transfer function matrices cannot be unitary.

Suzuki does not suggest the use of an orthonormal matrix. The matrix coefficients are constrained to those required by the horizontal angle Φ (See, col. 10, line 44 of Suzuki). It is not possible to meet this requirement and have an orthonormal matrix.

Gerzon is similarly constrained to produce delays and gains which are given in Equations 8 and 9. (Column 3, line 67, to Column 4, line 3.) The structure shown in Figure 5 of Gerzon cannot be unitary, because the adder (9) adds the summed output (25) of the delays (3_n) and the output (23) of the early reflection simulator (1) (fed from delays 4_n), which produces cross-coupled delays and a nonunitary result. The structure is inherently nonunitary and the various parameters chosen in such a way as to prevent a unitary response. Similarly, the systems shown in Figures 6, 8, 9 and 10 of Gerzon

are not unitary because the parameters are constrained by the requirement of generating source distance, and because the addition of delayed signals as shown does not produce a unitary system transfer function matrix.

Also, with due respect, the Examiner's statement that a finite impulse response (FIR) filter has no feedback and is therefore unitary is technically incorrect. FIR filters do not have unitary responses. The only linear system without feedback which has a flat frequency response is a single delay, and that is not an FIR filter. An FIR filter must have two or more delays combined to produce a controllable variation in frequency response.

More technically, single channel unitary filters are termed "all-pass", and require feedback to produce the all-pass response. FIR filters contain only zeros and no poles, and therefore cannot produce the all-pass response.

As an example, a FIR response is shown in Figure 1 below. The frequency response is not flat and so the single channel system is not unitary. Any other example will also be nonunitary.

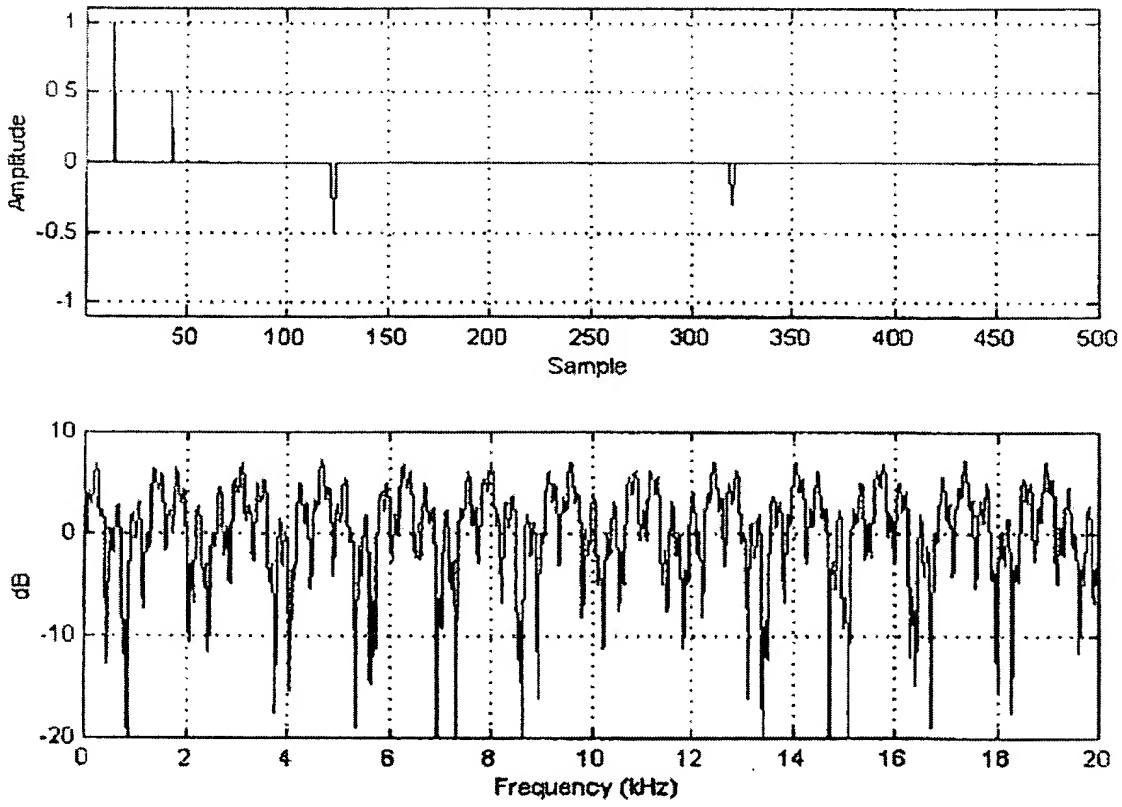

FIGURE 1

Figure 2 below shows an all-pass filter utilising feedback, which is unitary. Accordingly, it is incorrect to say that a filter which does not use feedback is therefore unitary, as Figure 1 shows.

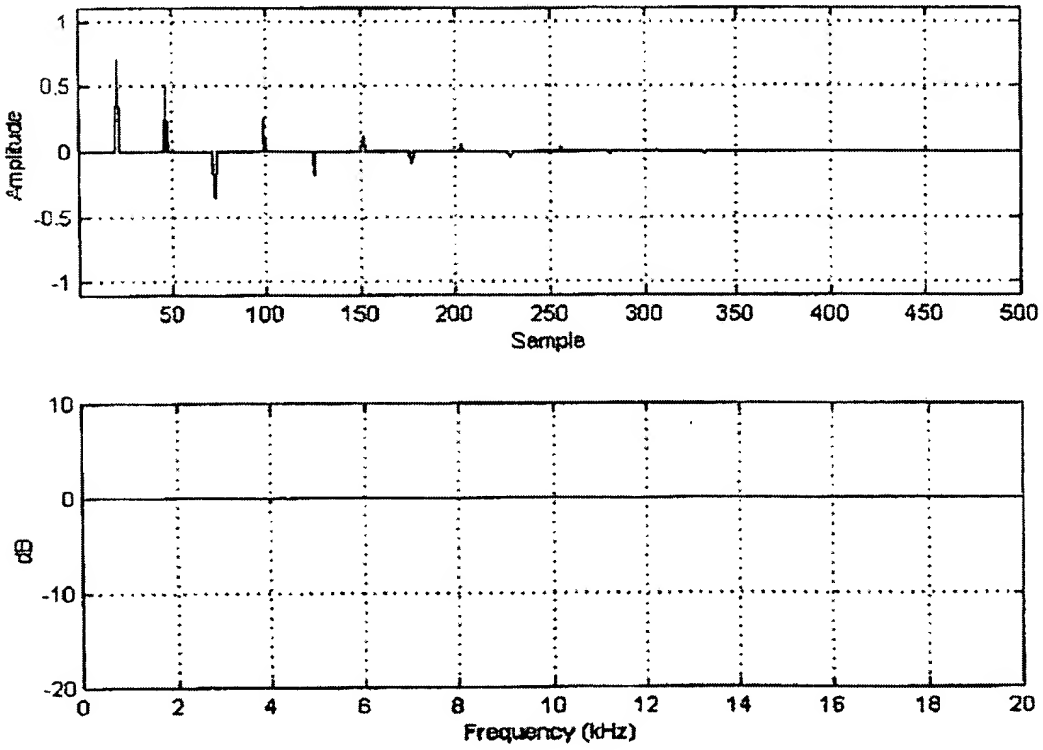

FIGURE 2

The vast majority of linear multichannel systems are non-unitary, and it requires very particular designs to produce a multichannel unitary response, as described above. Applicant's claimed system and method as set forth in Claims 1 and 8 respectively, which achieve a unitary response are not obvious in view of the systems or methods described in Suzuki or Gerzon.

The Dependent Claims

Claims 3-7 depend from Claim 1 either directly or indirectly and therefore, are patentable over Suzuki and Gerzon for at least the same reasons as Claim 1. Claims 10-12 depend from Claim 8 either directly or indirectly and therefore, are patentable over Suzuki and Gerzon for at least the same reasons as Claim 8.

CONCLUSION

In view of the foregoing amendments and remarks, it is believed that this application is now in condition for allowance. The Examiner is respectfully requested to reconsider the application in the light of the amendments and remarks presented hereinabove.

Respectfully submitted,

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